Exam 2 Info

Date: April 11th, 2019

Location: Normal classroom (HLL-009, Busch Campus)

Time: In-class (5:00-6:20 pm)

Notes:

1. Calculators and other electronic devices are **prohibited**. All calculations will be able to be completed by hand.
2. I will hold extra office hours on Wednesday (April 10th). I plan to be in my office from 2 pm - 4 pm (Hill 216). Feel free to stop by at any time in that interval (no need to email beforehand) with any questions you have. If this does not work for you, and you'd like to meet at some other time, please feel free to contact me via email, and I'm sure we can set something up.
3. You are allowed to bring **one** sheet of **handwritten** notes as a reference during the exam. I will not allow any typed sheets to be used, including the lecture notes (i.e. the main text).

Suggestions:

1. Read over covered sections in the textbook, as well as notes from class.
2. Understand all assigned homework questions and quizzes. Solutions to both are available on Sakai.
3. Do the review problems posted on the course site.
3. Solve other (unassigned) homework questions from the same section of the textbook.

Material:
The exam will cover roughly Chapter 4 of the Professor Ocone's notes, i.e. the basics of Markov chains with applications to population genetics (Moran and Wright-Fisher models are the motivating examples). Some key topics to review are given below. But be aware: this list is **not** exhaustive, and anything covered could appear on the exam. See the Course Calendar on the website for a complete schedule of the material covered.

Markov Chains (Chapter 4)

(a) Basic definition of stochastic processes. How to compute probabilities given transition probabilities. Basic "path" interpretation.

(b) Know some examples of stochastic processes, and how to mathematically construct from a model.

(c) Markov chains and Markov property. What this means in terms of computing the joint distribution of a path.

(d) State transition matrix A and state transition diagram. How to visually represent a Markov, and how to compute basic statistical quantities using A.

(e) Examples of Markov chains. Again, how to formulate mathematically from assumptions, and how to show something is a Markov chain. Examples to be familiar with include Wright-Fisher and Moran (with and without mutation/selection), random walks, birth-death processes, DNA mutation.

(f) Using linear algebra to compute spastical properties. Most important include how the distribution evolves, expectations, conditional expectations, and t-step transition probabilities.

(g) Using diagonalization to compute limiting distributions.

(h) Basics of simulating a Markov chain. Note that I did not cover in lecture, but it is part of HW#7, so I expect you to be familiar with the topic.

(i) Using conditioning to compute probabilities in Markoc chains. For example, probability of going broke in gambler's ruin, time to absorption in, etc.

(j) States of Markov chains. Recurrent, transient. Accessibility and communication classes. Definition of irreducible. Basically, understand the graph structure of a Markov chain, and what it says about the dynamics.

(k) Absorbing states. Basic limit theorems about chains with absorbing states (Theorem 4). Examples include Moran and Wright-Fisher without mutation, and random walk with absorbing states.

(l) Stationary distributions, and the corresponding limit theorems for irreducible aperiodic Markov chains. Examples include Wright-Fisher and Moran models with mutations. Again, closely related to linear algebra.